ORDER

1920.2

(Reprinted 5/90)

NATURAL DISASTER CONTROL

June 26, 1972

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Distribution: WAS/RD-2; WSM/FI-3; RAF-3; M-3; FOF-0 (minimum)

Initiated By: FI-420

RECORD OF CHANGES

DIRECTIVE NO. 1920.2

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL

FOREWORD

1. PURPOSE. The Airway Facilities Service has developed this directive, which summarizes procedures and construction modifications, to mitigate the effects of natural disaster at FAA facilities. Much of the information previously issued in various regional directives is consolidated herein, outlining preparations before, actions during, and recovery following certain anticipated or possible emergencies, and designating personnel responsible for coordinating and supervising activities. Some typical facilities are examined in detail; recommendations shall be applied to other facilities as appropriate. Construction modifications are directed to reduce damage from natural disaster and to facilitate for quick recovery after a disaster strikes.

2. DISTRIBUTION. This directive is distributed in FAA headquarters to the division level in the Systems Research and Development Service and Airports Service; to the branch level in the Airway Facilities Service; to the branch level in regional Airway Facilities Divisions; and to all field offices and facilities.

3. IMMEDIATE ACTION. A Natural Disaster Control Plan described in paragraph 3 of chapter 1 shall be developed by organizational elements and each region shall establish a program to implement appropriate construction modifications based on criteria contained in section 2 of chapters 2 through 5. Priorities for implementation should be based on local geographic hazards, criticalness of facilities, funds and personnel available.

4. REFERENCES.

   a. The following publications may be obtained through the regional headquarters distribution officer.

      (1) Handbook 1900.1 — FAA Defense Readiness Plan

      (2) Handbook 6930.1 — Fire Prevention and Maintenance of Fire Protection Equipment

      (3) Order 2500.8 — Operations vs. F&E Funding

   b. The following drawings may be obtained from the Department of Transportation, Federal Aviation Administration, Airway Facilities Service, FI-400, Washington, D. C. 20591.

      (1) D-5227 — Instrument Landing System, 40' Steel Antenna Tower-Welded, Glide Slope

(2) D-5583 Instrument Landing System, Extensions and Field Alteration to Glide Slope Antenna Tower, Structural Designs and Erection

c. The following NFPA Standard may be obtained from the National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110:

National Fire Code, Volume 7

J. W. COCHRAN
Director, Airway Facilities Service

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

1. NATURAL DISASTERS. All transportation modes in the present day exist and operate in an atmosphere of potential emergency. The best means for minimizing loss of life and property and reducing time required for restoring normal operations require adequate preplanning of the following: (1) actions to be taken when emergencies arise; (2) assignment of specific personnel actions; and (3) ensuring the availability of necessary equipment and facilities. Natural disasters to which facilities, both on and off airports, may be subjected include earthquakes, fires, floods, and storms. The vulnerability of a facility to any of these will, in good measure, be affected by geography since the more dangerous occurrences are often confined to certain areas or belts. The widespread dispersion of FAA facilities throughout the country makes it a certainty that some of these will be affected by natural disasters every year. While nothing can be done to avert them, there are actions that can be taken to minimize damage and expedite restoration of service. The actions described herein are aimed at maintaining capability to provide essential services by: (1) making plant modifications at disaster prone facilities; (2) prescribing preventive measures to be taken upon receiving a disaster warning; and (3) providing for early facility recovery after a disaster.

2. FACILITIES. Attention was given to the following typical facilities and structures to provide either continuous operation during a disaster or immediate recovery afterwards; modifications are to be applied to other facilities as appropriate.

   a. Trailers (Glide Slope, Localizer, VOR/TVOR)

   b. Type S Buildings

   c. Glide Slope Antenna

   d. ASR-4 Buildings

   e. ASR Towers

   f. VOR/TVOR Buildings

   g. Doppler Antenna Counterpoise

   h. Air Route Traffic Control Centers

   i. Airport Traffic Control Towers, Type "C"

   j. Airport Traffic Control Towers, Medium Activity

3. NATURAL DISASTER CONTROL PLAN.

a. General. Upon receipt of this handbook a Natural Disaster Control Plan shall be developed, similar to the plan discussed below, by each organizational element.

Protecting facilities during major natural disasters and getting them back into operation afterward can look like an impossible task. Unless preparations are made for such an emergency weeks and even months in advance, it will be difficult to assign personnel to specific tasks when a disaster is actually on its way. Now is the time to decide exactly what steps have to be taken before the disaster, during the disaster, and to assign the responsibility for each of those steps.

In small facilities, one may have responsibility for several functions; a large facility might establish a separate "task force" with different personnel for each of the major areas of responsibility. No matter how the total responsibility is divided up, all the responsibilities and jobs suggested below will have to be shouldered by someone; and they shall be preassigned to avoid costly oversights and wasteful duplication.

To make specific assignments, create a natural disaster organization chart. Keep it simple. Distribute it widely to interested municipal and civil disaster personnel. Then no one will have to rely on memory, everyone will know where responsibilities lie and where to look for authority. Identify on the chart the personnel authorized to put the emergency organization into effect.

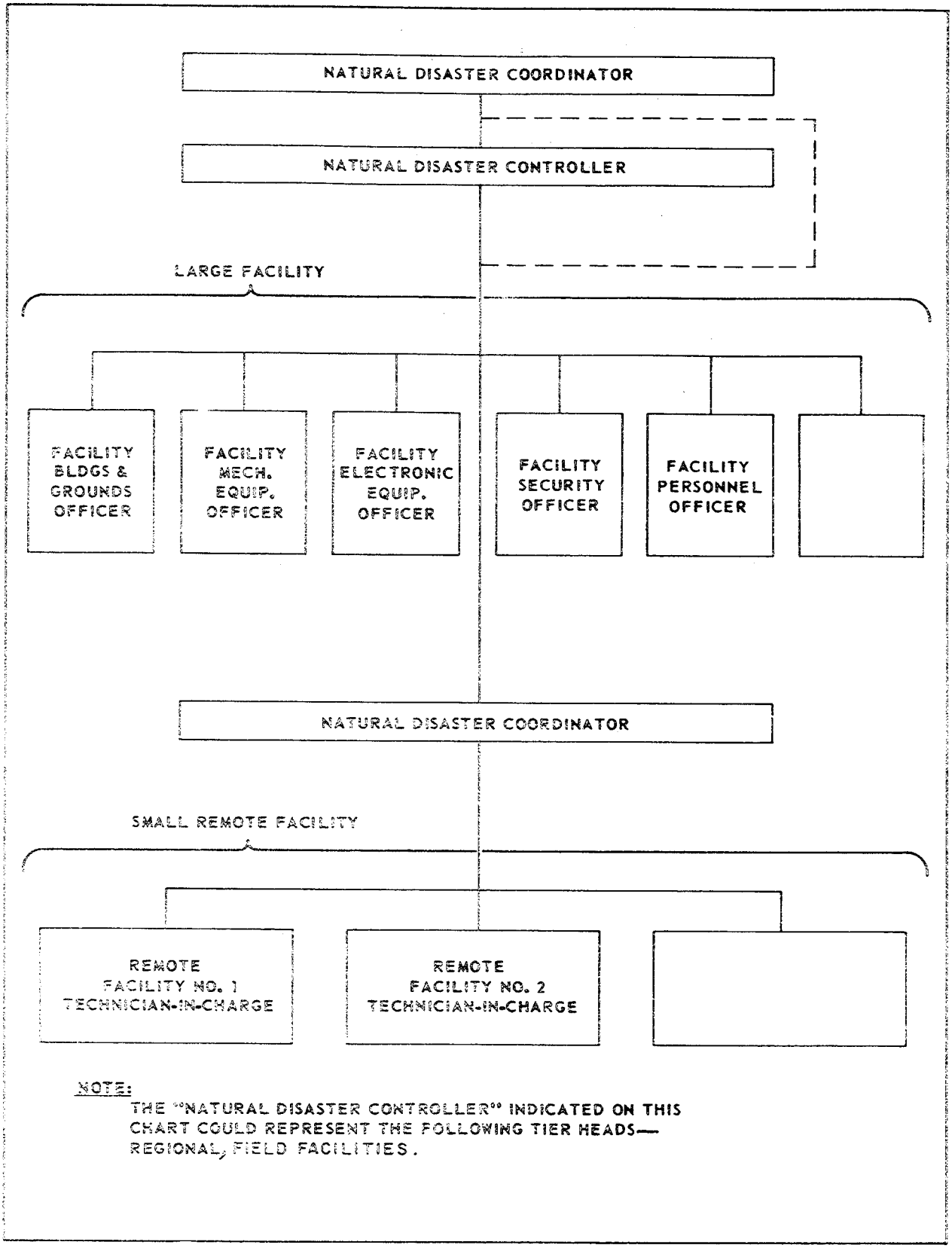
Figure 1-1 is a suggested natural disaster organization chart to be used for guidance purposes. Each organizational element shall develop a functional chart that will best fit its facilities. Top management shall give this plan continuing support, by informing all concerned of the overall policy and assigning the planning job to a responsible staff.

b. Missions and Job Suggestions. The following outline contains description of the missions of disaster control personnel, and the planning premises to be considered when preparing the plan.

Natural Disaster Coordinator

Overall mission. Provide leadership and direction to the disaster task force; and by authority of the Natural Disaster Controller, direct all activities at the facilities during periods of the disaster, including preparedness activities, periods of actual disaster, and restoration activities.

FIGURE 1-1. NATURAL DISASTER ORGANIZATION CHART (SUGGESTED)



NOTE:

THE "NATURAL DISASTER CONTROLLER" INDICATED ON THIS CHART COULD REPRESENT THE FOLLOWING TIER HEADS— REGIONAL, FIELD FACILITIES.

Job suggestions and planning.

(1) Assume overall direction of the disaster task force, establish priorities, and delegate authority.

(2) Develop procedures for all emergency actions.

(3) Establish a natural disaster headquarters communications center.

(4) Supervise the development and training of disaster task forces.

(5) For facilities located on airports, coordinate all natural disaster control plans and establish mutual aid agreements with airport management.

(6) Coordinate and establish mutual aid agreements with local community civil defense officials and military commanders in the area.

(7) Keep an emergency operation plan in readiness at all times.

(8) Maintain, or see that all task force personnel maintain a complete readiness checklist for each natural disaster listed in this handbook for each major area of responsibility.

(9) Compile and maintain a complete list of addresses and telephone numbers of all key disaster task force employees and keep it up-to-date.

(10) Coordinate and obtain advice and evaluation of the medical aspects of a facility from the appropriate center or regional Flight Surgeon's office.

Facility Buildings & Grounds Officer

Overall mission. Organize plans to minimize damage to buildings, site, and any equipment or structures on it; construct, rehabilitate and repair buildings and equipment and provide necessary utilities and building services to restore essential operation of the facilities.

Job suggestions and planning.

(1) Maintain, in a safe spot (natural disaster headquarters center) prints of building and structures, building services mechanical and electrical system diagrams, and piping and electrical arrangements. Be sure all prints are up-to-date as-built drawings.

(2) Keep notes of decisions made and action taken in a "disaster log", and be ready to take pictures right after the disaster for records.

(3) Determine which facility operating records must not be lost, and then put one set (or a microfilm copy) in a safe place away from the facility. Move the other records to the safest spot in the facility at the last moment.

(4) Prepare for a major drying out operation if records, prints, or manuals get rain-soaked or flooded. Locate in advance a blueprint or photographic dryer that can be used for mass drying.

(5) New buildings or additions under construction are vulnerable to damage and will probably require special bracing.

(6) Barricade or board up windows and doors.

(7) Supervise cleanup and recovery.

(8) Establish safe shutdown procedures for appropriate operating equipment and utilities.

(9) Provide for emergency use of all stored water and well supplies.

(10) Identify and schedule equipment and supplies for use during periods of natural disasters.

(11) Establish procedures for damage assessment, repair, and recovery operations.

(12) Compile and maintain a complete list of addresses and telephone numbers of all building and grounds maintenance personnel and keep it up-to-date.

Facility Mechanical Equipment Officer
and
Facility Electronic Equipment Officer

Overall mission. Plan to provide repair supervision or actual repairs to all electrical/electronic communication and control equipment and supporting mechanical ventilating/cooling system equipment.

Job suggestions and planning.

(1) Many people will be on temporary assignment involving unfamiliar work. Look over existing manuals, see which would be useful in their present form or with slight adaptation, then maintain a supply in a safe spot (natural disaster headquarter center).

(2) Build a library of data on renovation of damaged equipment.

(3) Most electrical and mechanical equipment must remain installed; however, be prepared to be able to move out some hard-to-replace special equipment. Decide which items call for this treatment, assign the men to do the job at the last possible minute.

Facility Security Officer

Overall mission. Provide for the protection of property; enforce rules and regulations; regulate and control traffic.

Job suggestions and planning.

(1) Maintain a trained, ready auxiliary security force to supplement the established unit.

(2) Provide for the protection of vital records and equipment.

(3) Establish security patrols as required to discourage looting.

Facility Personnel Officer

Overall mission. Provide for meeting natural disaster control organization manpower needs; recruit and assign personnel; develop and maintain occupational inventories; maintain records of personnel assigned to the natural disaster control organizations.

Job suggestions and planning.

(1) Maintain, in a safe spot (natural disaster headquarters center), a complete list of addresses and telephone numbers of all facility personnel, and a separate complete list of personnel assigned to the natural disaster control task force.

(2) Secure personnel for all elements of the natural disaster control task force.

(3) Food service for the task force should be arranged--both emergency rations and provision to support cooked food. Also obtain extra food that can be eaten without cooking. Plan for storage of extra drinking water. Plan only for quantities to support the natural disaster control task force personnel assigned during the disaster.

Technician-in-Charge

Overall mission. Perform all duties of the officers described above.

c. Alternates. When a natural disaster strikes, personnel assigned to natural disaster task force responsibilities shall be relieved of their normal operating activities and other provisions made to replace them. The employee's normal duties shall be performed by an alternate or an assistant. Alternates shall also be assigned to assume the natural disaster control responsibilities in the event the primary designee is unavailable or incapacitated.

4. RESOURCE INVENTORY. The Natural Disaster Control Plan shall include a complete inventory of all resources that may be called upon in an emergency. Few facilities, regardless of size, have all the equipment at the site necessary to handle a major emergency or disaster. It is essential, in order to assure use of nearby resources, that agreements be made between the facility management and the heads of other organizations or local contractors. It is equally important that it be clearly understood what actions are required upon the receipt of certain information or signals; who will respond; how the information is to be sent; and who is responsible to pay for services rendered.

a. Inventory List. The listing shall include a description of fixed equipment and services, such as power supply, including both commercial sources and standby engine generators; fuel supply; communications, including telephones, radio, and any intercom systems; the water supply system, including location of hydrants, water pressure, capacity of any reservoirs or storage tanks, and location and capacity of pumps; and a brief description of first aid or medical services and facilities. Emergency equipment shall be started and tested periodically to ensure that it is operable when needed.

b. Mutual Aid Agreements. Resources for which mutual aid agreements can be arranged shall also be listed. These will normally include local police and fire departments, nearby airport resources, rescue squads, physicians, registered and practical nurses, commercial utilities, and contractors who can furnish heavy construction equipment. Common labor to fill sandbags against a flood may be obtained by agreements with local government units or by standby arrangements with local contractors.

c. Additional Assistance. Field Facilities Offices will request the Airway Facilities Division to provide additional assistance specifying the locations or facilities for which help is urgently needed. The assistance may be regional office engineers or assembly or additional work crews from other areas not affected by the disaster. The Airway Facilities Division coordinator will alert those areas adjacent to the damage and, when necessary, seek additional assistance in manpower and materials. Critical matters to be considered are those of transportation, identifying the source of supplies and materials, and maintaining a smooth flow of communication with all those involved.

5. GENERAL PREPAREDNESS. In many respects, general preparations for natural disasters are similar to those required by FAA defense readiness plans. Natural disaster and defense preparedness efforts shall be coordinated to avoid duplication.

a. Maintenance Shop. Unless the regular shop is in a well protected spot, establish a secondary headquarters from which to operate during and after a disaster. Designate an existing available building large enough to set up equipment and tools and located where it is not likely to be flooded or badly battered. Put here, well in advance, duplicates of vital records (names, phone numbers, assignments of maintenance personnel, utility layout drawings, etc.).

b. Hand Tools. Shovels, rakes, and the like are indispensable, and next to impossible to buy after a disaster. Store a supply in the emergency shop area; post a check list of the emergency cache of tools and check periodically for readiness. Portable power tools are vital and easily damaged. An individual shall be assigned to round them up and store them in a safe spot when a disaster warning is received.

c. Emergency Equipment. Such items as portable generators, portable heaters, portable shelters and other similar equipment shall be accessible during an emergency. Check them out to make sure they are in working order. If electric power is lost, motorized gasoline pumps are inoperable; therefore, portable hand fuel pumps, for fueling vehicles and portable equipment, should be available. On receipt of disaster warning, all fuel tanks shall be kept full, and emergency fuel supplies shall be stored in properly sealed 3- or 5-gallon cans or drums that can be safely carried in the trunk of a car. When carrying gasoline filled cans in trunk of a vehicle with an operating 2-way radio, shutdown radio prior to loading cans and leave radio shutoff during the transportation period.

d. Emergency Supplies. Adequate stock of inexpensive supplies shall be kept on hand. These include flashlights, fresh batteries, portable emergency lights, tags, solvents, oil for transformers and filters, meggers, air blowers, wire fuses, rust preventives, buckets, paintbrushes, rope, cable extension cords, waterproof tape, waterproof paper, greaseproof paper, wiping rags, squeegees, tarpaulins, raincoats, and rubber boots.

e. Availability of emergency tools, equipment, and supplies is vital when a natural disaster occurs. Stocked items shall be segregated from normal use items and shall not be used except in an emergency. Any items used will be immediately replaced. Where prestocking is not feasible, essential items must be made available through prearranged sources of supply and these sources shall be clearly identified in the resource inventory in the Natural Disaster Control Plan.

f. Control Charts. A natural disaster headquarters center shall be established with maps, charts, and project control boards. A map of each facility and its environs to a distance of two to five miles beyond the facility boundary shall be prepared. Provide a grid overlay with labeled coordinates showing grid lines close enough together, depending on the map scale, to aid in locating facilities accurately. Details on the map shall include the location of hydrants, gates, frangible sections of fences, access roads, and power vaults, as well as adverse terrain and bridge load limitations.

6. POST EMERGENCY OPERATIONS. As soon as disaster conditions subside, actions shall be initiated to restore operations and salvage facilities and equipment. Procedures discussed below shall be expanded and modified to suit local facility requirements.

a. Restoration of Operations.

(1) Re-establish access to facility sites.

(2) Secure structures against the elements.

(3) Electric power is likely to fail during a disaster. Where emergency power supply is not automatically activated, portable equipment shall be connected as soon as conditions will permit. Normal power shall be shutoff at main switches. When normal power is restored, feed lines must be meggered and checked for continuity before discontinuing temporary service and switching on normal power supply. Some mechanical systems may have to be shutdown because of breaks in main fluid lines. When restored to service, isolate branch lines by local valves before opening the main, and check each branch system for leaks as it is brought on the line.

(4) Take immediate steps to restore power, heat, and air conditioning or ventilation where vital to facilities operation; repair or replace equipment as required to get navigation and communication systems functioning.

b. Salvage Procedures.

(1) The extent of damage shall be summarized and reported to the Regional Director with a proposed schedule for rehabilitation and a breakdown of supplies and equipment replacements that will be required, as described in paragraph 7, below.

(2) Check facilities sytems for fluid leaks and for weakened structures and connections which, though still intact, may be in danger of failure. Inspect all exterior electrical ground connections.

(3) After facilities are back in operation, noncritical repairs and general cleaning operations can be implemented. Remove all special temporary protective measures installed in advance of the storm. Restock emergency equipment and supplies and establish a status of preparedness for the possiblity of another disaster.

7. COMMUNICATIONS.

a. Central Control Point. The Natural Disaster Control Plan shall make provision for the establishment of a Central Control Point to be activated in the event of a major emergency. It will be here that instructions are issued for overall control of the emergency. The Central Control Point must have an emergency power generator, adequate fuel storage, and radio communications, since electric and telephone lines are likely to be out of service.

b. Alerting System. A suitable communications and alerting system shall be established by each organizational element and shall be incorporated into the Natural Disaster Control Plan.

c. Plan in Writing. Because of the unfamiliar jobs that have to be done before, during, and after a natural disaster, the only way to make sure they all get done is to put them in writing. A simple checklist shall be prepared for each major area of responsibility.

(1) The Natural Disaster Control Plan shall be used to acquaint the personnel concerned with the actions expected of them. It shall be carefully studied and exercised so that reaction to specific emergency situations is automatic, and it shall be prepared in sufficient copies so that each member (on or off the facility) of an emergency crew will have his own copy.

(2) Copies of Emergency Documents shall be stocked at the Central Control Point, including emergency organization chart, all job checklists, copies of assignments for men on duty, duplicate prints of locations of key utilities and fire-fighting equipment, and lists of emergency equipment and its location.

d. Damage Reports. As soon as possible after a disaster, an initial damage report shall be made to the regional office. Additional reports shall be made daily and continue for as long as directed. Reports shall include the following:

(1) Extent of damage (include major items completely destroyed).

(2) Operational capabilities.

(3) Major shortages or deficiencies.

(4) Recommendations for restoration priorities.

(5) Progress being made in the restoration of facilities.

(6) Requests for regional assistance to restore services that cannot be handled from local resources.

(7) Recommendations for restoration projects that will require assistance outside of regional capabilities.

e. Documentation.

(1) Photographs showing "before" and "after" condition of facilities damaged in a natural disaster are an invaluable aid in analyzing avoidable deficiencies for improved rehabilitation. "Before" photographs shall be accumulated and filed as they become available. "After" photographs shall be taken as soon as practicable following a disaster.

(2) Prints and records of building structure and utility lines shall be kept up-to-date and stored in a safe place to facilitate restoration.

8. SECURITY. For those facilities where classified material is present, plans shall be made to protect the classified information from compromise during periods of excitements associated with a natural disaster. Few facilities have guard forces assigned to them. At other facilities, arrangements shall be made with local, military, and State Police to furnish appropriate security measures. Plans shall be made for setting up control points at all access roads or entrances to the facility to regulate traffic movement and prevent access except to those who are authorized to enter. Guards shall be posted around any damaged facility and access roads shall be kept open to facilitate passage of emergency vehicles. Authorized personnel shall be issued arm bands or other forms or identification that can be seen from some distance.

9. PERSONNEL TRAINING. Any training required as a result of this directive shall be developed and conducted by the FAA.

CHAPTER 2. EARTHQUAKE

SECTION 1. GENERAL INFORMATION

10. CHARACTERISTICS.

a. Description. Earthquakes create horizontal ground movement which act against the inertia of a structure, resulting in a tendency for the foundation to slide out from under the structure. Connections must have either enough strength to resist stresses occurring from the horizontal forces, or enough flexibility to allow horizontal movement between ground and structure. Vibrations from earth tremors can loosen bolts, break pipes, short out wires, and breach dams and reservoirs.

b. Susceptible Geographic Areas. There are few places in the United States that are not subjected daily to earthquakes, but most are so slight as to be below the level of sensory perception. Figures 2-1 and 2-2 are seismic risk maps which divide the continental United States and Hawaiian Islands into four zones: Zone 0, areas with no reasonable expectancy of earthquake damage; Zone 1, expected minor damage; Zone 2, expected moderate damage; and Zone 3, where major destructive earthquakes may occur. A listing of Alaska cities and their seismic zones are as follows:

LOCATION	SEISMIC ZONE	LOCATION	SEISMIC ZONE
Adak, Aleutian Islands	3	Kodiak	3
Anchorage	3	Kotzebue	1
Annette	1	McGrath	2
Attu	3	Middleton Is.	3
Barrow	1	Nikolski, Umnak Is.	3
Bethel	1	Nome	1
Cold Bay	3	St. Lawrence Is.	1
Cordova	3	Shemya Island	3
Fairbanks	3	St. Paul Island	1
Gambell	1	Umiat	1
Juneau	2	Wales	1
King Salmon	3	Yakutat	3

Personnel shall know in which seismic zone each facility is located and shall take precautions as appropriate; if there is any doubt as to which zone, choose the higher one. Precautions indicated in this chapter are particularly applicable to seismic zones 2 and 3.

FIGURE 2-1. SEISMIC RISK MAP OF CONTINENTAL UNITED STATES

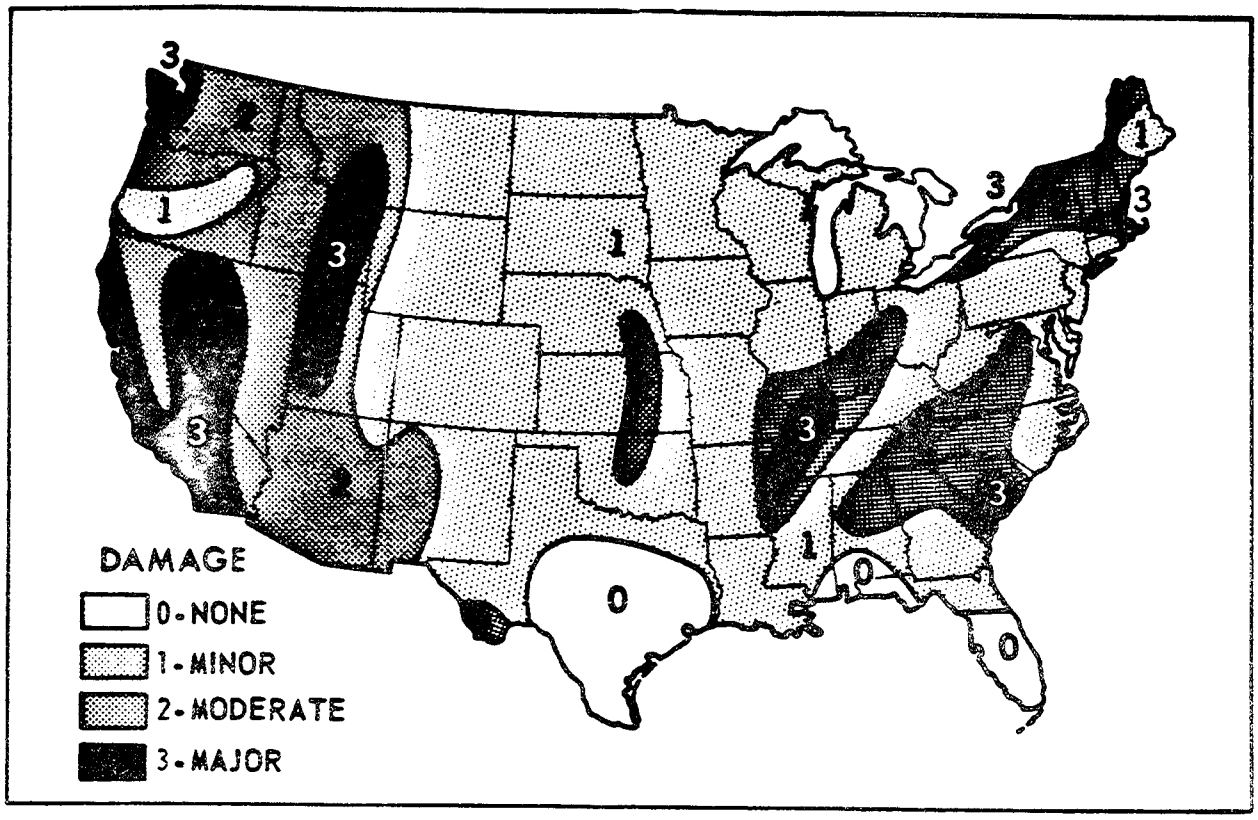
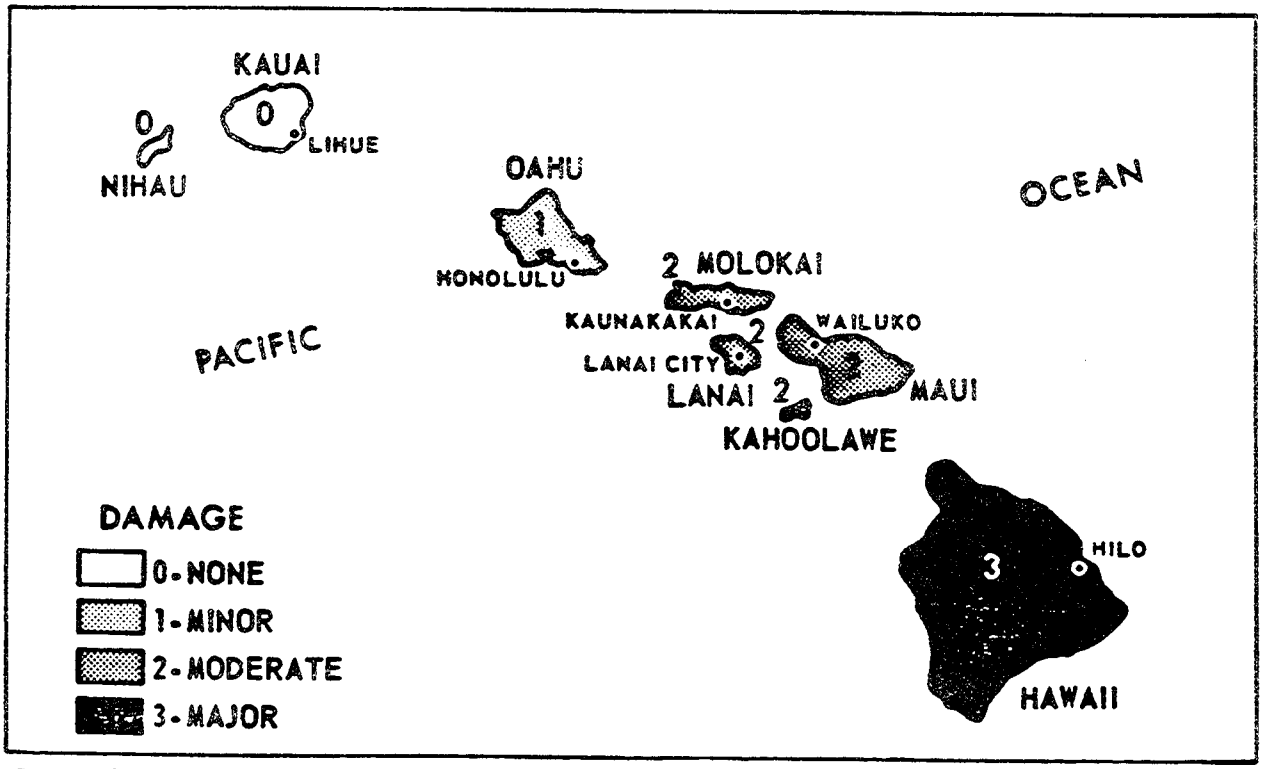


FIGURE 2-2. SEISMIC RISK MAP OF HAWAIIAN ISLANDS



11. RESPONSE LIMITATIONS. Earthquakes occur without warning and may continue over a period of several days, with individual shocks varying in length from a few seconds to several minutes. The dangers to expect are generally building collapse, falling debris, fire, and possibly flood.

There is no action that can be taken during the earthquake to minimize damage except to get personnel away from buildings that may collapse and to be prepared to extinguish fires.

a. Fires almost invariably result after earthquakes. The precautions and procedures discussed in chapter 3 will apply, with the added danger that the earthquake may have damaged water mains resulting in a lack of water pressure for firefighting.

b. Floods may accompany earthquakes in areas where protective dikes, sea walls, dams, etc., are vulnerable to earthquake damage. Flood protection procedures are discussed in chapter 4.

c. Protective measures for earthquakes center on proper design and construction of facilities. Since there is little or no warning in advance of an earthquake, there are no temporary measures that can be taken. Construction must be permanent and a constant state of readiness maintained. Structural design in accordance with local building codes in major earthquake areas will help to minimize damage to buildings. The remaining problem is cleanup and restoration after the shocks subside.

SECTION 2. PREPLANNING

12. EMERGENCY MATERIALS. Supplies of tarpaulins, waterproof roofing paper, asphalt, flashings, caulking compound, glazing, and lumber will be needed and may not be available from local vendors immediately after a severe quake. Emergency supplies are discussed in chapter 1 under resource inventory.

13. MODIFICATIONS TO STRUCTURES. Upon receipt of this handbook, facilities in areas subject to earthquakes shall be examined with regard to mitigating effects of earthquakes, and programs shall be initiated to accomplish appropriate modifications. Some typical examples are as follows:

a. ASR Building.

(1) Anchor air handling unit and A. C. coil to floor.

(2) A. C. compressors located outside the building shall be securely fastened to the pad. Where units are stacked, install a bracing frame similar to that shown in Figure 5-8, chapter 5.

b. ASR Towers. Check all steel member connections for tightness--tighten if necessary. Replace loose or missing field connections with appropriate bolts and locknuts.

c. All Facilities. Make sure there is some slack in electrical wiring in wire ways or provide flexible conduit connections, especially in the short verticals from the horizontal trunk to equipment cabinets

14. POST EMERGENCY OPERATIONS. Procedures necessary to restore operations, and implement salvage and cleanup after occurrence of any natural disaster are discussed in chapter 1. Additional operations applicable to earthquake disasters are as follows:

a. Check thoroughly the structural integrity of building and antenna structures. Tighten nuts and bolts on structural steel work; bolted tower structures, for example, are especially vulnerable.

b. Check plumbing connections for leaks. Pipes making rigid connections from building structure to heavy equipment or to underground are likely spots.

c. Check ductwork for leakage at elbows and tees.

d. Inspect electrical connection for firm contact. Exterior ground connections are especially vulnerable; resistance shall be measured after the quake to detect underground breaks.

e. Radar tower alignment may have to be checked with a transit if radar reception is not the same as before the earthquake.

CHAPTER 3. FIRE

SECTION 1. GENERAL INFORMATION

15. CHARACTERISTICS. The different general characteristics of localized and multiple fires influence the effectiveness of response by firefighting personnel and equipment. Technical characteristics are described in FAA Handbook 6930.1, Fire Prevention and Maintenance of Fire Protection Equipment, Chapter 2.

a. Localized Fire. This is an isolated fire in a single building or portion of a building. It may spread to adjacent areas if not detected and promptly controlled.

b. Multiple Fires covering a large area. These are a series of fires resulting, at different locations, from a common cause--an earthquake, flood, or storm. Multiple fires overtax all firefighting facilities. Firefighters are summoned to many areas at one time, and they face obstacles other than the fire itself. Access to the site may be obstructed by debris or a collapsed roadway or bridge; water mains may be ruptured; wind and flood waters may hinder orderly coordination of the firefighting effort. Often no attempt can be made to put out the fire until these adverse external conditions subside.

16. PROTECTIVE MEASURES. FAA Handbook 6930.1 describes some fire protection procedures in detail. There are three basic approaches to protection against destruction of property by fire:

a. Prevention. Precautionary measures taken to lessen the likelihood of a fire igniting.

b. Extinguishment. Preparation and procedures to put out or contain a fire.

c. Salvage. Preparation and procedures to enable property to survive a fire with a minimum amount of damage. Contrary to common usage, the term "salvage" includes procedures to mitigate fire loss in advance of and during emergency, as well as post-emergency procedure.

17. RESPONSIBILITIES AND PRIORITIES.

a. Personnel are responsible for fire prevention through construction and maintenance of facilities with fireproof or fire resistant materials, maintenance of electrical wiring to ensure proper connections and insulation, safe storage procedures for hazardous items such as paint, fuel batteries, etc., and periodic inspection of facilities.

b. Extinguishment of structural fires is the responsibility of the municipal fire department, except at remote facilities where there is generally no municipal fire company.

(1) In the interest of saving life and protecting property on airports, the municipal fire department may be supplemented by the use of airport aircraft firefighting equipment and personnel, if available, provided that such use does not detract from an airport fire department's capability to protect aircraft operations. Both the equipment in use by airport fire departments and the training of their personnel are specialized and not adapted to the fighting of structural fires, and their use in supplementation of municipal fire departments shall be considered only as an emergency measure.

(2) Provide appropriate building accessories, such as fire detection systems, sprinklers, hydrants, and portable extinguishers. First responsibilities are to give an alarm to the fire department and make certain that all persons who do not have assigned firefighting and salvaging responsibilities are evacuated from the fire area. Use of a portable fire extinguisher can frequently put out a small fire before it develops into a major disaster. Efforts to extinguish a fire, however, shall not be permitted to delay notification of a trained firefighting organization. Fire department emergency numbers shall be conspicuously posted near all telephones.

c. A well-rounded salvage program will require action both by the facility personnel and by the municipal fire department. Each has primary responsibilities.

(1) The municipal fire department's responsibility for salvage is limited in that it is an emergency force protecting lives and property at the time of a fire or similar emergency. It is not its job to provide the manpower or equipment to a facility for post-emergency salvaging operations or for handling considerable amounts of stock which may have to be moved following the extinguishment of a fire. It is the duty of fire departments to get their companies back into service as promptly as possible so as to be ready to respond to subsequent calls. A municipal fire department understands salvage principles and will probably be available to advise the facility personnel regarding procedures which should be followed for their own protection. The primary responsibility for post-emergency salvage rests with facility personnel, although the better public fire departments generally are prepared to render certain assistance which may be needed immediately before employees, repair contractors and salvage workers reach the scene. The amount of salvage work the municipal fire department may be prepared to do varies with local conditions and availability of personnel.

(2) The extent to which valuable contents may be damaged in a given emergency is influenced in a large measure by the extent to which a loss prevention program is carried out before such an emergency occurs. Good salvage practices allied with good maintenance and operating methods are generally recognized as management responsibilities.

(3) Fire breaks shall be installed and maintained around all remote facilities.

18. WARNING.

a. Notification procedures shall be established to initiate immediate response to a fire. Response must be carefully preplanned to avoid hesitation and confusion when a call is sounded. Alarm systems shall be in accordance with N.F.P.A. standards (National Fire Code Vol. 7, notably Articles 250 and 310).

b. Since fires may accompany storms, floods, and earthquakes, warning of either of these impending disasters shall be taken as a fire warning and stringent fire precautions shall be exercised in conjunction with the preparations.

SECTION 2. PREPLANNING

19. COOPERATION WITH OTHER ORGANIZATIONS.

a. Emergency telephone numbers of the municipal fire department, public utilities, medical services, and local and state police headquarters shall be posted at all telephones. Management shall also have the telephone numbers of local contractors equipped to assist in salvage work. It is desirable to make advance arrangements for such assistance as may be needed following a fire, storm or water emergency. In some communities there are firms specializing in such work.

b. Local municipal fire departments shall be contacted to ascertain whether or not the equipment assigned to respond to fires has a standard complement of salvage tools, equipment and manpower trained in their use, and to assure coordination between fire company equipment and FAA facilities, e.g., hydrant wrench sizes, etc.

20. SMOKE AND WATER DAMAGE. A considerable portion of fire loss is not the result of direct fire damage, but is due to smoke and water damage. Electronic equipment is especially susceptible to smoke and water loss. The danger often lingers after a fire has been extinguished and shall not be overlooked in planning for salvage. Provide waterproof cover protection for electronic test equipment when not in use.

21. INSPECTION. Annual facility surveys shall be conducted to check (1) susceptibility of materials to damage, (2) storage methods and procedures, (3) salvaging equipment methods and procedures, and (4) trained personnel available for salvage work. These surveys shall be conducted as part of a detailed fire prevention inspection. Inspections shall include a careful check of self-contained firefighting equipment; periodically charge extinguishers; check hoses and nozzles, fuel in mobile equipment, and water supply. The annual salvaging survey shall be a joint inspection conducted in cooperation with the local municipal fire department. Keep the municipal fire department informed regarding valuable equipment which may require special efforts in an emergency. In general, it is desirable to ask the municipal fire department to assist in making the salvaging survey so that they will be familiar with the specific valuable equipment which may need protection. Needless damage to buildings and contents can be avoided when the municipal fire department is aware of salvage problems peculiar to the facility.

22. INDOCTRINATION.

a. Effective salvaging operations depend in large measure upon the organization and training of employees for emergency operations, including the use of both portable fire extinguishing equipment and salvage equipment and appliances.

b. The local fire department can generally advise on safe storage of materials subject to damage and on salvage equipment that is desirable or necessary.

c. Firefighting equipment shall not be used for nonfirefighting duty.

23. IDENTIFICATION OF PIPES AND VALVES. An important part of the salvage job is the marking and identification of valves, piping and floor drains which are important to the reduction of water damage and the removal of water. Be prepared to shutdown pipelines that carry gas, gasoline, or other flammable materials.

24. MODIFICATION TO STRUCTURES. Upon receipt of this handbook, facilities shall be examined with regard to mitigating effects of fire, and programs shall be initiated to accomplish appropriate modifications. Some typical examples are as follows:

a. Trailer, ASR-4 building, Type "S" building, VOR/TVOR building. In facilities protected by a local municipal fire department, provide a fire monitoring system as follows:

(1) Install, at the facility, an ionization smoke detector. (One detector head is adequate unless a ceiling obstruction 12 inches deep or greater, divides the space.)

(2) Transmit signal to monitoring station by means of any spare telephone or control wires available. Install, at the monitoring station, an appropriate indicating light with associated relays as required.

(3) If spare wires are not available, provide by leasing or other means a monitor circuit from the facility to the monitoring station with appropriate warning light and appropriate relays as required for facilities deemed to be critical.

SECTION 3. OPERATIONS DURING EMERGENCIES

25. SALVAGE PROCEDURES.

a. Personnel shall be assigned to start salvaging operations as quickly as possible after the initial attack on a fire has commenced. A fundamental of good salvaging operations is to cover exposed materials quickly with tarpaulins or waterproof paper before smoke and water damage occurs. Firefighting personnel shall ascertain that automatic sprinklers and other fire protection equipment are operating properly.

b. Salvage during an emergency shall be accomplished as follows:

(1) Place waterproof covers over exposed stock or equipment.

(2) Remove endangered materials which are portable.

(3) Promptly shutoff water flow to ruptured piping.

(4) Use care in the use of extinguishing agents, including water streams, so as to avoid unnecessary damage.

(5) Remove smoke by ventilation. Use power operated fans where available.

(6) Promptly shutoff automatic sprinklers when it is certain that the fire is out (this should be done only upon orders of the chief in charge of the firefighting).

(7) Remove excess water by means of drains, chutes, runners, drain holes, scuppers, squeegees and other available means.

(8) Power to the facility should be shutoff before anyone enters building to prevent injuries from electrical shock.

c. Special attention shall be given to the protection of areas immediately below a fire or water flow. In most instances, there will be a slight delay, before water penetrates openings in floors and ceilings, during which preventive measures can be taken by properly trained personnel.

d. In many instances valuable salvage work time can be saved, after the main body of the fire has been put out, by removing water and smoke which could further damage the building or contents if allowed to remain.

e. Salvaging operations are particularly important in facilities protected by automatic sprinklers. Fire department salvage equipment includes sprinkler tongs or wedges for stopping the flow from individual sprinkler heads when a fire is extinguished or in case a head is operated accidentally. Wooden sprinkler wedges should be fabricated in advance and kept immediately accessible to any facility and space sprinkler heads be obtained and stored at the facility. This is a faster method of stopping flow than shutting the main sprinkler valve because frequently the system drains through an open head for some time after the valve is closed. Stopping one or two heads promptly does not prevent the balance of system from operating.

26. SECURITY. Refer to paragraph 8, chapter 1, for security of the facility before, during, and after a disaster. The fire department normally is in charge of the premises as long as firefighting apparatus and personnel remain at the scene; the fire department may leave a detail of men with a line hose to retain possession until the facility can be secured. A fire watch must be maintained until all chance of rekindle is past.

27. POST EMERGENCY OPERATIONS. Procedures necessary to restore operations and implement salvage and cleanup after occurance of any natural disaster are discussed in chapter 1.

CHAPTER 4. FLOOD

SECTION 1. GENERAL INFORMATION

28. DESCRIPTION. Floods are generally designated as flash floods, long duration floods, and seacoast floods caused by high winds or seismic sea waves. River floods are often described in terms of how often they are likely to occur, such as every 5, 10, 20, 50, or 100 years.

a. Flash floods and long duration floods are caused by heavy rains or by rapid melting of snow and ice, resulting in rivers and streams overflowing and covering land that is not usually under water. Obstructions in streams beds and culverts (ice cakes, trees, building) may cuase overflows and flooding in excess of expectations. Rivers and streams sometimes receive ten times as much water as their beds will hold.

b. Seacoast floods are caused by high winds which pile water up and onto the land; or by seismic sea waves sometimes called "tidal waves" caused by volcanic activity or underwater earthquakes. Seismic waves travel at speeds between 300 and 500 m.p.h. In the open sea, the wave height may be only a few feet, but builds up to great heights (the record is over 200 feet) as it nears shoal water. An extensive network of warning stations has been established to report time of occurrence, speed of movement, point of origin, and probable effect on land areas.

c. Susceptible geographic areas. Flash floods, often debris-laden, occur in the arid and semiarid regions, and in mountainous areas. Seacoast floods caused by high winds can occur along any coastal area. Seacoast floods caused by seismic sea waves usually occur along Pacific coastal and island areas. Flood maps are prepared on a local basis; therefore, each AF division shall contact the local Corps of Engineers for pertinent flood data in the area and distribute it to the sector offices. Ask old residents and utility companies about the extent of flooding at FAA sites, and frequency of occurrence. Be alert to changes in land use which would result in heavier runoff during rains and thereby subject site to flooding. If a site can be expected to be put out of commission by floods oftener than once every ten years, recommend its relocation.

29. RESPONSE LIMITATIONS. The precautionary emergency actions associated with floods are limited in scope and effectiveness. Dikes and sea walls will help some, but the force of the moving water will smash most structures.

a. Evacuation. Action to evacuate portable equipment and supplies from vulnerable areas shall be taken promptly. The Disaster Control Plan in coastal areas shall provide for fast dissemination of alerts and prompt response by personnel.

b. Security. Refer to paragraph 8, chapter 1 for security of the facility before, during, and after a flood.

30. WARNING. In general, with the exception of flash floods or the unexpected breaching of a levee or reservoir, there is adequate warning to allow time for protective measures.

a. Tidal Wave. Arrival of the wave at shoreline is preceded by a marked lowering of the water level which may last for some time and which will serve as an immediate warning, supplementing the alert from the warning network.

b. The National Weather Service will provide data on flood buildup in the area and will notify the public of potential danger.

SECTION 2. PREPLANNING

31. PLANNING FOR SALVAGE. Emergency actions in connection with floods are best assigned to the engineering forces.

a. General. Procedures for evacuation of materials and equipment shall be planned upon receipt of this handbook. Don't wait until the danger of flooding is imminent. Furniture and equipment, so far as possible, shall be moved to higher elevations when severe flooding is expected. Check pumps frequently to insure that they are operable. Fire is always a hazard during floods, and a combination of broken powerlines with floating fuel is an invitation to further disaster. Special attention should be given to the protection of electrical systems and fuel supply.

b. Facilities. Listed below is a partial checklist to protect vulnerable facilities and utilities. This checklist shall be expanded and modified to suit local facilities and conditions.

(1) If feasible (depending on the anticipated flood state), place sandbags around all doors and ground level openings in walls and around electrical or mechanical equipment.

(2) Check guys and braces of antenna masts, above-ground tanks, etc. Watertight the fuel tank fill pipes and if earth moving equipment is available, push additional dirt over undergound tanks. In flood prone areas on a cost vs. benefit basis, pour a concrete slab over the top of the underground fuel tanks and anchor down above ground tanks with concrete piers and straps.

(3) Plan routine maintenance, in coordination with local power companies, on incoming power lines to be sure weak poles have been braced or replaced.

(4) Boiler rooms and pump houses will be essential in postflood cleanup. Give them all possible protection, such as, placing sandbags around ground level openings, temporary raising of loose mechanical and electrical equipment, benches and equipment lockers.

(5) Foundations may need protection against undermining, especially at corners, pipe entrances, etc. Tank and loading dock foundations are a particular source of danger. Consider trying to divert water with sandbags or temporary bulkheads; try to anticipate course of the water flow; work in advance.

(6) Doorways and openings can be a major source of trouble if water rises above the sill. Sandbags or timber bulkheads can be a big help.

(7) Move inside all loose objects such as drums, tools, benches, etc.

(8) Fell any trees that might bring down wires.

(9) Keep culverts and ditches clear of debris, ice, and snow to avoid unnecessary flooding or washouts.

c. Equipment. About all that can be done to protect mechanical and electrical equipment and materials is to make every effort to keep them from getting wet, rehabilitate them if they do. Shutdown air conditioning equipment to prevent short-cycling after power is restored. Electronic equipment can possibly be raised if cable slack is available. In some cases, standby electronic and power plant equipment can be removed. Removal shall be at the discretion of the controlling facility.

32. ACTIONS DURING A FLOOD.

a. Electronic power should be left on as long as possible, but the switch shall be pulled without hesitation when any branch circuit or component of the system is endangered by flood waters.

b. Monitor main lines to keep pumps, etc., in service, disconnecting sections as they become damaged by flood actions.

33. MODIFICATIONS TO STRUCTURES. Upon receipt of this handbook, facilities shall be examined with regard to mitigating effects of flood, and programs shall be initiated to accomplish appropriate modifications. Research of each site flood history should be conducted first to ascertain the 50-year flood level. The research information will dictate the action necessary at each facility. The research should include FAA site history as well as local area history. One of the most common areas of flood damage will be access roads; preventive measures should be programed to

limit damage and may dictate relocation of portions of the road to prevent isolation of the facility. Some typical examples of modifications are as follows:

a. Trailer (Glide Slope, Localizer, VOR/TVOR). Anchor trailers to their respective mounting pads, as illustrated in Figure 5-4, Chapter 5, to prevent float-away or wash-away action if high or torrent waters hit the facility.

b. VOR/TVOR. Consideration shall be given to raising outside installed dry type transformers susceptible to water damage, and voltage regulators located in the emergency generator room above the 50-year flood level.

c. ARTCC. Know where you can rent two (2) portable engine-driven lift pumps for basement flooding use. Pump size--300 G.P.M. @ 20-ft. suction lift; with 30 ft. long suction hose and strainer, and discharge hose long enough to clear the building.

d. All Facilities.

(1) Tie down or move inside materials and equipment that could float away.

(2) Potheads or terminal or junction boxes shall be raised above expected flood stage or replaced with waterproof types. This applies to telephone as well as power cables.

(3) Securely fasten to the pad, air conditioning compressors located outside the building, as illustrated in Figure 5-8, Chapter 5, to prevent float-away or wash-away action if high or torrent waters hit the facility.

(4) Exterior cable boxes below the 50-year flood stage shall be given added protection by plastering with roofing compound.

34. POST EMERGENCY OPERATIONS. Procedures necessary to restore operations and implement salvage and cleanup after occurrence of any natural disaster are discussed in Chapter 1. Floors at or near grade are especially vulnerable to flood damage; be prepared to remove mud and debris quickly to provide access within building.

CHAPTER 5. STORM

SECTION 1. GENERAL INFORMATION

35. INTRODUCTION. Damage to facilities resulting from storms has often been extensive. The types of storms of particular interest are typhoons or hurricanes, and tornadoes. Hurricane damage results from two principal factors, wind and water. High velocity winds (187 miles per hour recorded at Grand Isle, Louisiana--Hurricane Betsy 9 September 1965) caused structural damage to antennas, electric and telephone poles, transmission lines, buildings, trees, etc. High tides and torrential rains result in flooding and related water damage. Tornado damage results primarily from wind. In both tornadoes and hurricanes, much damage is done by debris thrown at a high velocity.

36. CHARACTERISTICS.

a. Typhoons or Hurricanes. The terms "typhoon" and "hurricane" are synonymous and refer to a cyclonic storm with winds in excess of 75 miles per hour. Such storms occuring in the Pacific Ocean and Indian Ocean areas are called "typhoons"; those in the Atlantic Ocean, the Gulf of Mexico, and the Caribbean Sea are called "hurricanes." They rotate in a counterclockwise direction in the northern hemisphere around a calm center or "eye." The diameter of the storm may be as much as 1,000 miles. Because of the large radius of rotation, the winds appear to be moving in a straight line. However, as the center moves past the observer, the wind direction is reversed; if the eye passes directly over the observer, the shift in wind direction will be marked by an intervening short period of calm. The paths of hurricanes are erratic and often turn back over areas already struck.

b. Tornadoes. Tornadoes or "twisters" are the most violent of windstorms. Unlike the hurricane they develop without warning and are relatively short-lived. They are seasonal and occur mostly in the Mississippi Valley and Central Plains States. Tornadoes are generally associated with unstable air, heavy thunderstorms and black clouds, out of which they descend in a familiar "funnel" shape. The diameter of rotation is generally small--often 100 yards or less--and the velocity of the winds in the funnel has been estimated in the neighborhood of 500 mph. The winds spiral upward, with the upwind velocity as high as 200 mph. As a consequence, the winds not only destroy structures but tend to lift them from the surface, carry them some distance, and drop them again.

c. Susceptible Geographic Areas. Typhoons or hurricanes generally originate over open ocean, but their erratic paths often carry them over land areas. In the Atlantic Ocean they occur most frequently in the Caribbean Sea, sweeping northwesterly across the islands in that sea, then northward along the Atlantic Coast of the United States, finally veering out to sea again and dying out in the

North Atlantic. Others cross into the Gulf of Mexico and turn northward into the Gulf States. As they move inland, wind velocities decrease. In the Pacific Ocean, they are more common in the islands near the equator and in the Western Pacific. Tornadoes appear to be almost peculiar to the United States and, while they may occur in almost any section, there is a reasonably well defined "tornado belt" extending through Texas, Oklahoma, Kansas, Nebraska, Missouri, Indiana, Iowa, and Illinois. In general, high velocity winds with great destructive force are encountered in almost every section of the United States. Figure 5-1 illustrates sections of the United States most susceptible to hurricanes. Areas are shaded according to frequency of hurricanes; numbers indicate the number of times destruction was caused by hurricanes from 1901 to 1955. Figure 5-2 illustrates sections of the United States most susceptible to tornadoes. Areas are shaded according to frequency of tornadoes; numbers indicate the counting of first point of contact with ground tornadoes from 1916 to 1955.

37. WARNING. The National Weather Service observes the development of weather patterns, predicts and tracks the movement of storms, estimates the buildup in wind velocities, and notifies the public of potential danger resulting therefrom. There is usually advance warning for hurricanes, typhoons, and other storms involving winds of high velocity. In general, tornadoes afford little warning and action is limited to taking shelter on short notice and in recovery operations.

38. RESULTING FIRE AND FLOOD. Although hurricanes are typically accompanied by extremely heavy rain and flooding, fires may also occur. Fire is also a hazard following tornadoes because of the finely splintered debris and broken fuel and power lines that so often result. Hazards include broken power lines, shorted electrical equipment, gas from broken mains, flammable liquids from tanks and broken lines, and unusual hazards--for example, tightly packed textiles that have become damp may start to burn due to spontaneous combustion.

a. Fire Protection. Sprinkler systems are often destroyed, and dependence must be placed on portable or wheeled fire extinguishers. Check fire extinguishers and other fire protection equipment to be certain they are in good working order. Stringent fire precautions should be set up in advance. Assign responsibility for cutting power, shutting off gas and other utilities as soon as they become a fire hazard. Protect chemicals and flammable materials from water. Absolutely prohibit smoking. Assign someone to anticipate unusual fire hazards beforehand. Preparations and emergency procedures for fires are discussed in Chapter 3.

b. Flood Protection. Fill and place sandbags if there is any possibility that the storm may be accompanied by floods. Chapter 4 deals with emergency activities associated with floods.

FIGURE 5-1. PATH OF HURRICANES IN UNITED STATES

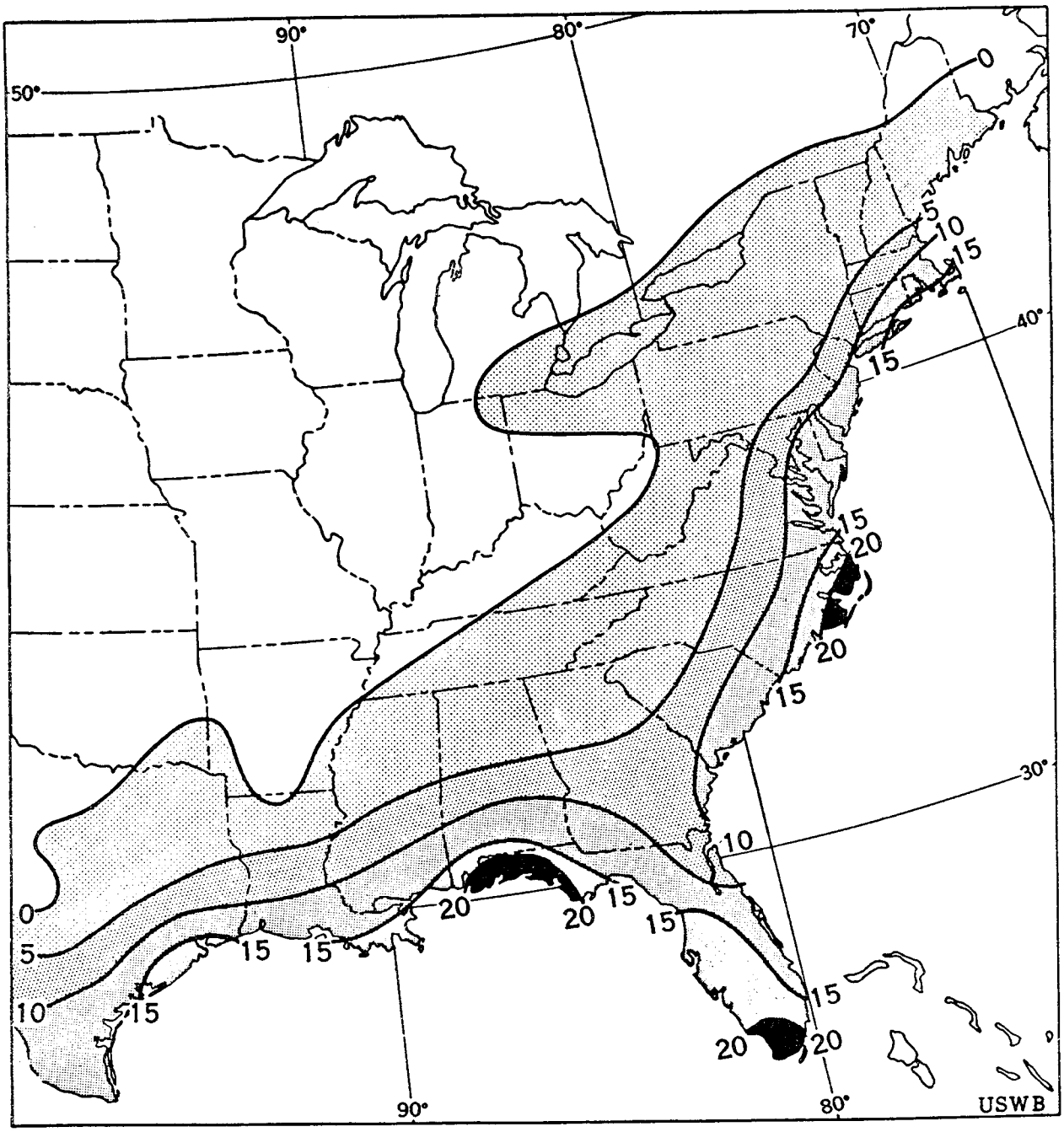
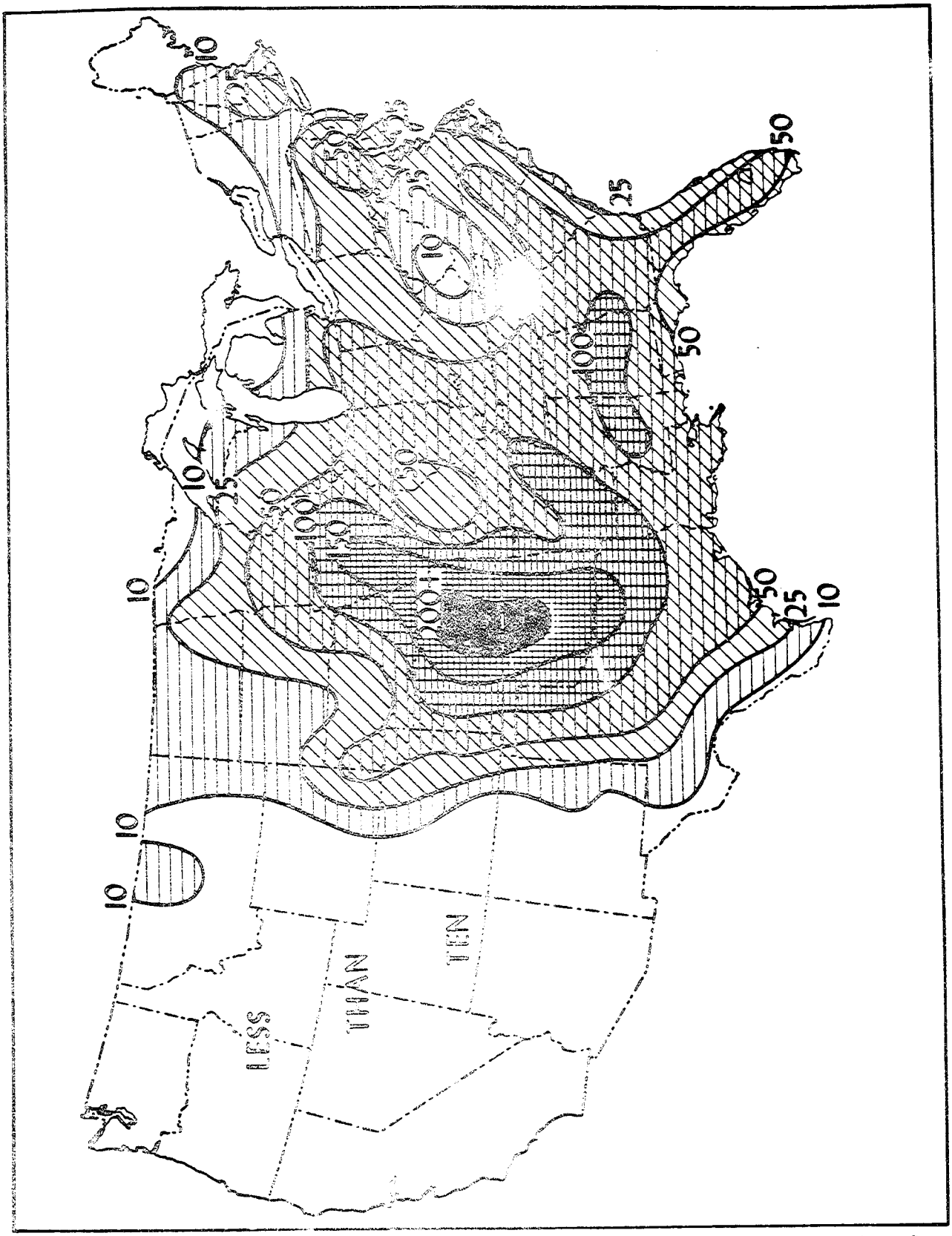


FIGURE 5-2. TORNADO BELT MAP OF UNITED STATES



SECTION 2. PREPLANNING

39. PREPARATION FOR STORM CONDITIONS. Guidelines shall be established for each facility that lies within the general storm area in advance of the storm season. When a storm warning is received, supervisors and other responsible employees shall use these guidelines as a checklist so that all necessary actions can be taken in a timely and effective manner. Conduct an exercise to determine whether or not the planned action will be practical and effective.

a. Equipment and Facility Check. An itemized checklist shall be prepared for immediate response upon receipt of a storm warning. The list given below shall be expanded and modified to suit the facilities and conditions in each organizational element.

(1) Check all engine generators under full load for a time sufficient to insure that the engine generator will, if necessary, automatically pickup the load and furnish power to the facility.

(2) Check the tension of all pole and tower guy wires. (Loose guys will allow towers or poles to oscillate in high winds resulting in damage or collapse.) Check connections of antennas to towers. Make certain bolts, pipe and reflector mounts, etc., are tight. Where the glide slope facility is to be removed from service, the antenna and monitor detectors should be removed and stored in a safe place. All antenna cables shall be securely tied to the mast to prevent wind/rain damage to the cable.

(3) Board up or tape windows to prevent wind damage.

(4) Doors and unmanned buildings shall be secured by tying or locking them shut.

(5) All loose material around site shall be securely tied down or moved to a location where it is least likely to be picked up by the wind.

(6) Transceivers installed in Sector and Area vehicles shall be serviced to ensure continued operation for use when necessary during a storm. Be prepared to substitute these units to restore any facility communication disabled by the storm. When carrying gasoline filled cans in trunk of a vehicle with an operating 2-way radio, shutdown radio prior to loading cans and leave radio shutoff during the transportation period.

(7) Circularly polarized transmitting antennas atop ATCTs are quite large and offer considerable wind resistance. The mounting and guys should be inspected and supplemental guys added if necessary. If winds in excess of 100 mph are expected, these antennas shall be removed from their mountings and lowered to prevent possible damage to roof, glass areas, etc.

(8) Check the mountings of all above-ground tanks. If tanks are empty or nearly empty, they can be further stabilized by filling them with fuel before arrival of the storm. Consideration should be given to permanent straping as set forth in paragraph 31b(2).

(9) Drive wooden stakes (2 x 4) against ventilator hoods to help hold them in place.

(10) Check tanks for adequate supply of fuel for engine generators.

b. Radar Antenna Rotation Speeds. Figure 5-3, indicates maximum wind velocities that radar antennas can be expected to withstand, both under rotating and nonrotating conditions. Steady winds, or gusts, to the velocity shown in Figure 5-3 will be sufficient to cause to stop antenna rotation. The wind velocity for stopping the antenna rotation should be less than the maximum allowable limit. Particular circumstances, such as air traffic control requirements, may demand risking the antenna because of an urgent need for continued operation of the radar. At the local level, the decision to stop rotation of ASR type antennas shall be made jointly between Air Traffic and Maintenance personnel.

FIGURE 5-3. SAFE WIND VELOCITY, ROTATING ANTENNAS

Type Facility	Rotating (Wind Velocity in Knots)	Nonrotating (Wind Velocity in Knots)
ASR-3B, ASR-3M, ASR-4, ASR-5, ASR-6, ASR-7 with or without Beacon Antenna	80	130
CPN-18	52	If wind in excess of 52 knots is forecast and suspension of radar service can be tolerated, the antenna should be lowered, blocked, and tied securely.
ARSR-1 (no radome)	80	110
FPS-66 Pressurized Radome	Antenna to be stopped when the wind velocity exceeds 109 knots.	
FPS-27 Pressurized Radome	Antenna to be stopped when the wind velocity exceeds 52 knots. The FPS-27 tower will be nonoperational during wind velocities exceed 87 knots.	

NOTE: Radars equipped with rigid radomes are built to withstand hurricane winds. Permitting the antenna to "windcock" in strong wind is recommended up to the maximum nonrotating wind velocity. Tie-down of the antenna is recommended if maximum wind velocity predictions are received long enough in advance, and the suspension of radar service can be tolerated.

c. Personnel Safety. It is recommended that, when feasible, the transmitter site and antenna area be vacated when wind velocities approach the maximum velocities for the rotating or nonrotating conditions.

40. PLANNING FOR SALVAGE. Fast delivery of emergency materials just before or after a storm is not likely. Where practical, provide supplies of tarpaulins, waterproof roofing paper, asphalt, flashings, caulking compounds, glazing, and lumber. Maintaining emergency supplies is discussed in Chapter 1.

41. UTILITIES. Power interruptions are common during hurricanes either by damage to generating plants or destruction of transmission lines.

42. MODIFICATIONS TO STRUCTURES. Upon receipt of this handbook, facilities shall be examined with regard to mitigating effects of storms, and programs shall be initiated to accomplish appropriate modifications. Some typical examples are as follows:

a. Trailer (Glide Slope, Localizer, VOR/TVOR).

(1) If on pedestal foundations, guy down at each top corner, eyebolt to trailer wall near corners. Guying arrangement and details are illustrated in Figure 5-4. Eyebars and guy foundations shall be installed. Guy lines, in hurricane areas, can be placed when hurricane warning is received and may be removed after storm. In tornado areas, guys should remain permanently in place.

(2) If on concrete pad, anchor with 3/4 inch diameter anchor bolts at 2 feet o.c. or 3/4 inch cinch bolts at 1 foot, 6 inches o.c. Weld angle brackets to trailer channel frame to accommodate bolts.

(3) Protect unhooded louvers, if any, with welded heavy gage hoods.

b. Type "S" Building.

(1) Board-up windows with fire retardant treated fireboard (Presdwood). See Figure 5-5.

(2) Install 5 ply built-up roof if roof panel joints are subject to leaks. Roofing felts shall be mechanically fastened (nailed to wood, or attached with low density fasteners to rigid insulation) at 4 inch centers at edge of sheet and 8-inch centers staggered in two rows running longitudianal to the sheet. For nonnailable decks, base felt shall be mopped solid. Provide two units of slag or gravel surfacing. Where rigid insulation is used on metal decking, it shall be attached with not less than 8 mechanical fasteners per sheet. Roof edges shall be secured

FIGURE 5-4. HOLDDOWN FOR TRAILER VANS

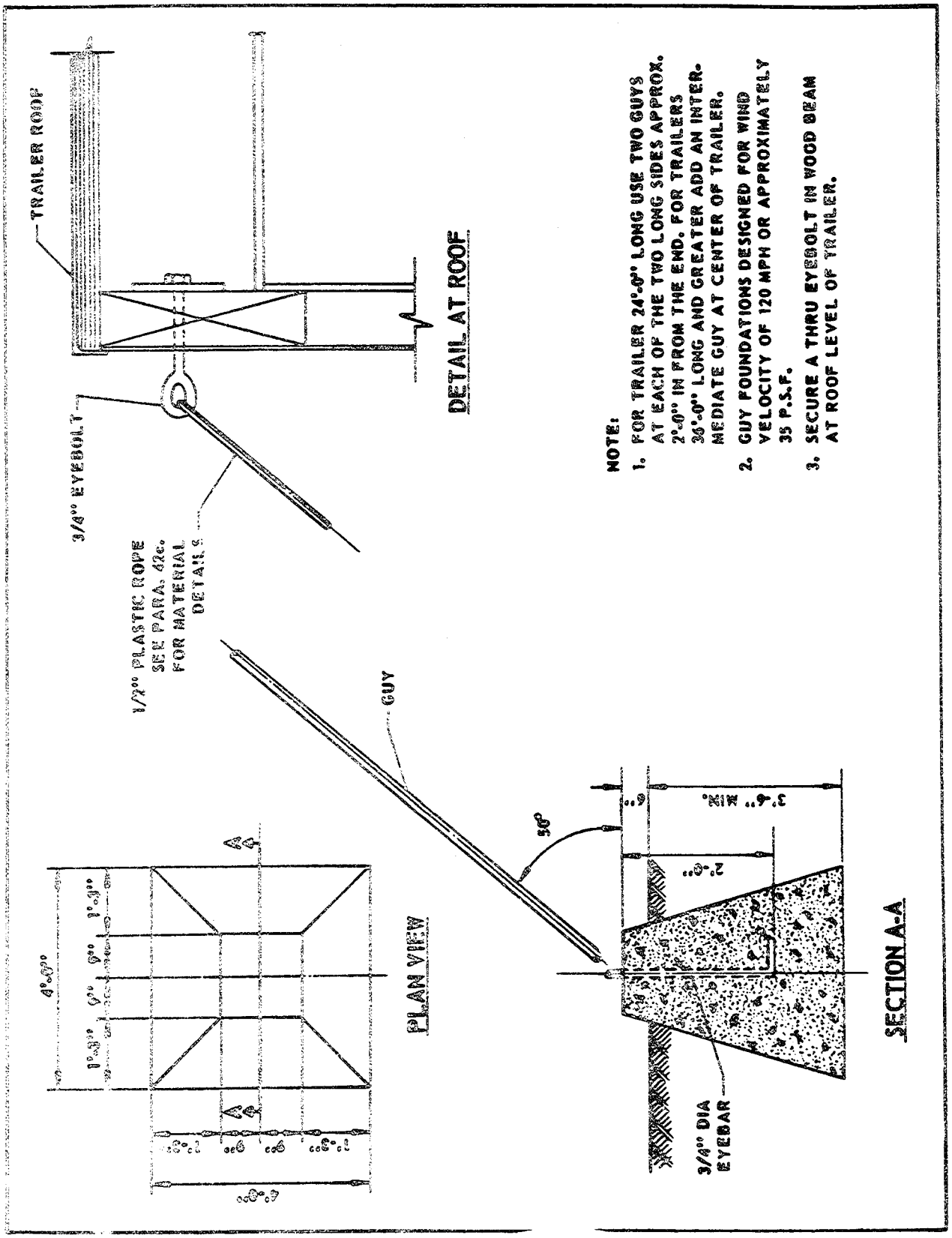
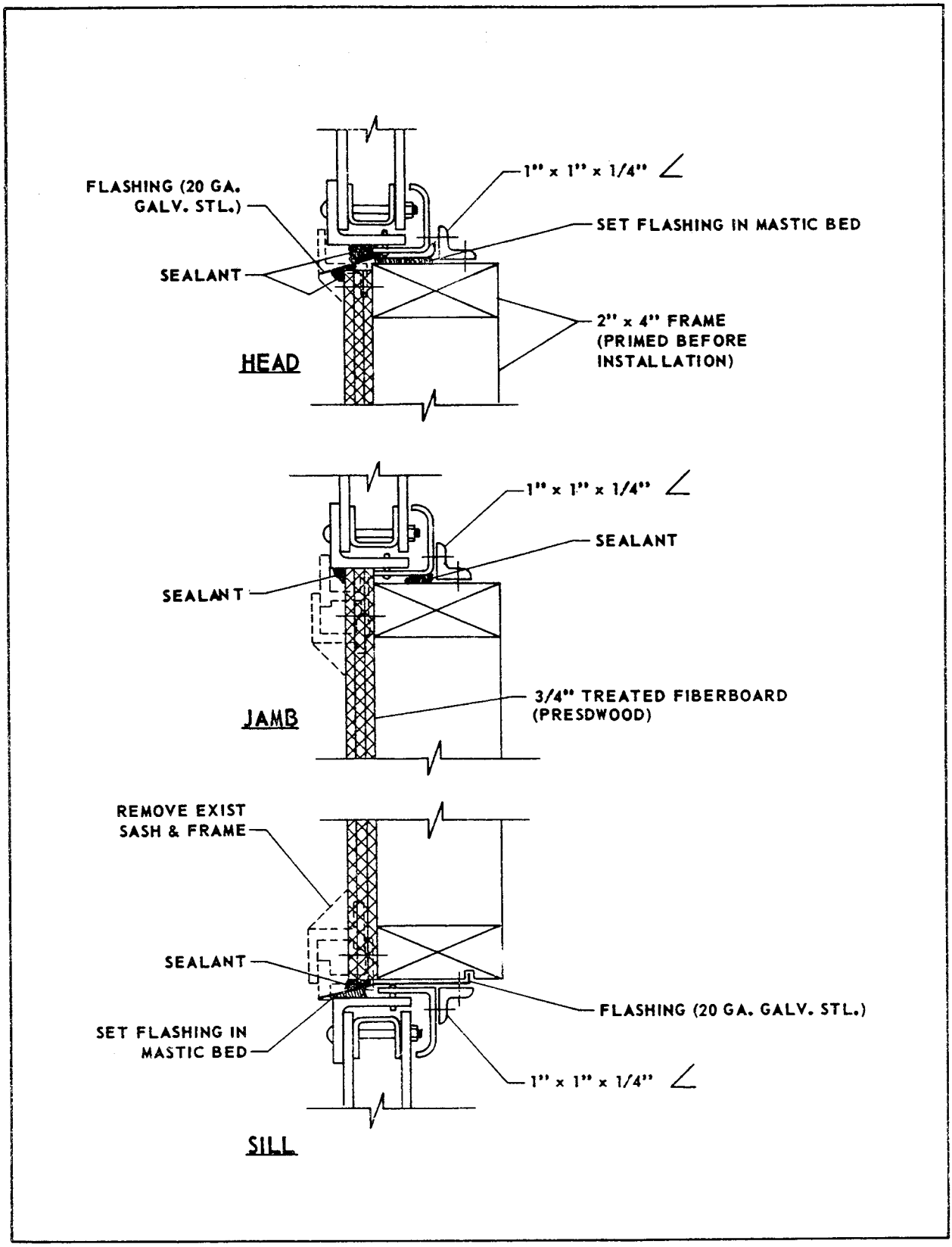


FIGURE 5-5. WINDOW CLOSURE, TYPE "S" BUILDING



with 12 gage or heavier metal edging mechanically fastened through top flange at 4-inch centers and through face at 8-inch centers. Roofing construction shall withstand an uplift force of 40 lbs. per square foot, and 50 lbs. per square foot at eaves.

(3) On 12 x 12 foot structures install a continuous 3 x 6 x 1/4 inch-bent plate, screwed or welded to roof deck at each flute and screwed to top of type "S" panel at 1 foot o.c. and through-bolted (1/2 inch diameter), with gaskets, to channel closure at 2 feet o. c. See Figure 5-6.

c. Steel Antenna Tower (Glide Slope). Each capture effect glide slope mast shall be guyed regardless of height. Each null reference glide slope mast having a mast-mounted monitor shall be guyed if the mast is more than 40 feet high. All guys shall be of plastic rope, and shall be installed as soon as practicable. Guying material, location of guys installation procedures are as follows:

(1) Plastic rope material shall be of polypropylene, mylar or dacron. To enhance visibility and longevity, and if available, the rope shall be colored yellow with dye dispersed throughout the material and shall incorporate an ultra-violet absorber in its formulation.

(2) The plastic rope shall be 1/2 inch diameter, having a minimum breaking strength of 4200 pounds and be of strand interwoven construction.

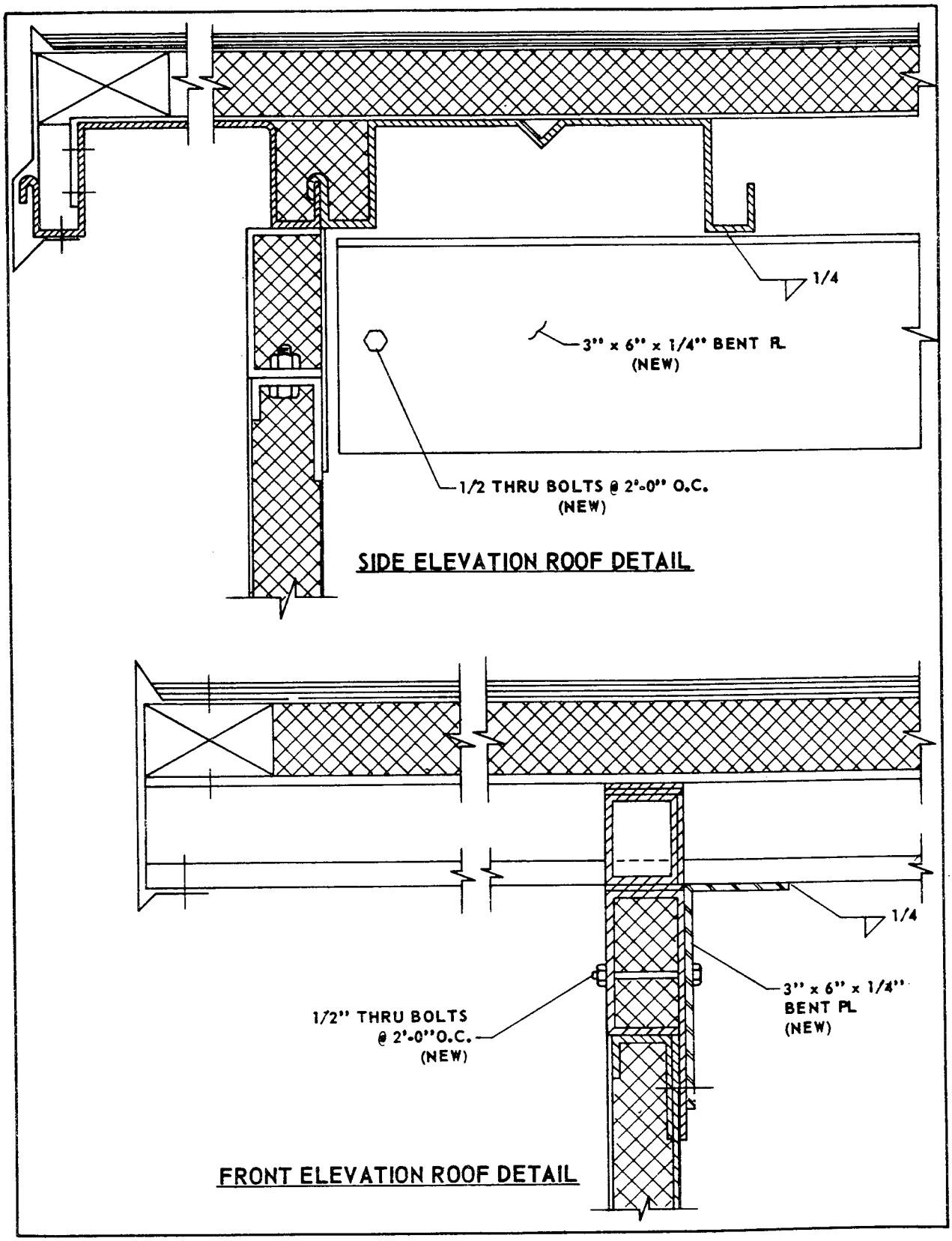
(3) The bottom 5 foot section of the back guy shall be of 1/4 inch diameter, 1 x 7 galvanized steel wire rope as specified on Drawing D-5583. This steel portion is to check the initial tension with the shunt type dynamometer.

(4) All guy hardware shall be in accordance with Drawing D-5583; except heat type, wedge sockets may be used for the top ends of the guys shall be capable of "take-up" in addition to the turn-buckle capacity.

(5) Sources for procurement of plastic rope are: Sears, Roebuck & Company; Penn Fibre & Specialty Company, Inc., 2028 E. Westmoreland Street, Philadelphia, Pennsylvania United States Plastic Rope, Inc., 2481 Spring Street, Redwood City, California 94063; and Columbian Rope Company, 309 Genessee Street, Auburn, N. Y. 13021.

(6) Guy anchors shall be 120 degrees apart and located so that the guy makes an angle between 40 degrees and 50 degrees from horizontal. (See Drawing D-5583.)

FIGURE 5-6. ROOF HOLDDOWN, TYPE "S" BUILDING



(7) Guys (one set of three guys) shall be attached to the tower at a point 10 feet 8 inches below the top, as shown on Drawing D-5583.

(8) All guy connections to the tower shall be made as shown on Drawing D-5583 when tower leg is under no load condition.

(9) Initial tension shall be 400 pounds ± 100 pounds.

(10) All bolted field connections shall be as specified on Drawing D-5583 and shall be made by using the structural lock nuts as indicated on this drawing. Tighten all bolts as indicated on drawing.

(11) The above guying instructions apply only to towers fabricated in accordance with Drawings D-5227 and D-5583. For other tower designs, direct requests for guying instructions to FI-400.

(12) Anchors for the guys shall be provided; see Figure 5-7 for guy anchor foundation details. Guy ropes shall be installed on a permanent basis.

d. VORTAC.

(1) At all locations where the shelter is secured to the counterpoise with lag screws, the screws should be removed and replaced with bolts.

(2) The conical shelter shall be guyed to the counterpoise with fiberglass guys at a minimum of three points.

e. ASR-4 Building. A. C. compressors located outside the building shall be securely fastened to the pad. Where units are stacked, they will act as a sail to high velocity winds. Install a bracing frame similar to that shown in Figure 5-8.

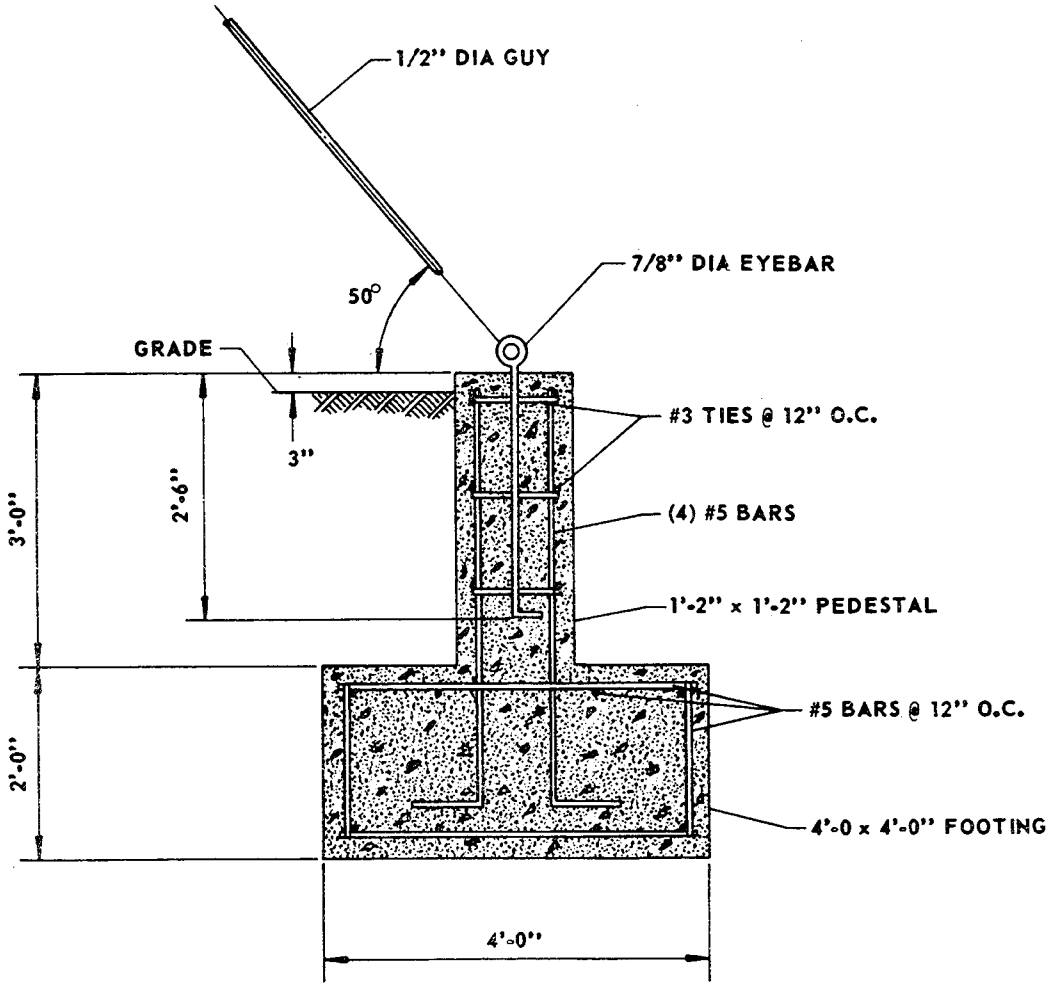
f. ARTCC. At sites located in areas subject to flooding caused by hurricanes have available two (2) portable engine drive lift pumps as specified under Paragraph 33c, Chapter 4, Flood.

g. ATCT Type "O". To preclude driving hurricane rains from entering the building at the tower roof line, endangering short circuiting of the main disconnect switch, apply continuous caulking to the open space between the roof closure angle and the wood blocking shown in Figure 5-9.

h. All Facilities.

(1) Tie down or move inside stored materials and equipment that can be blown away.

FIGURE 5-7. GUY ANCHOR, GLIDE SLOPE ANTENNA TOWER



PROVIDE 3 ANCHORS 120° APART

FIGURE 5-8. A.C. UNIT HOLDDOWN (SHEET 1 OF 2)

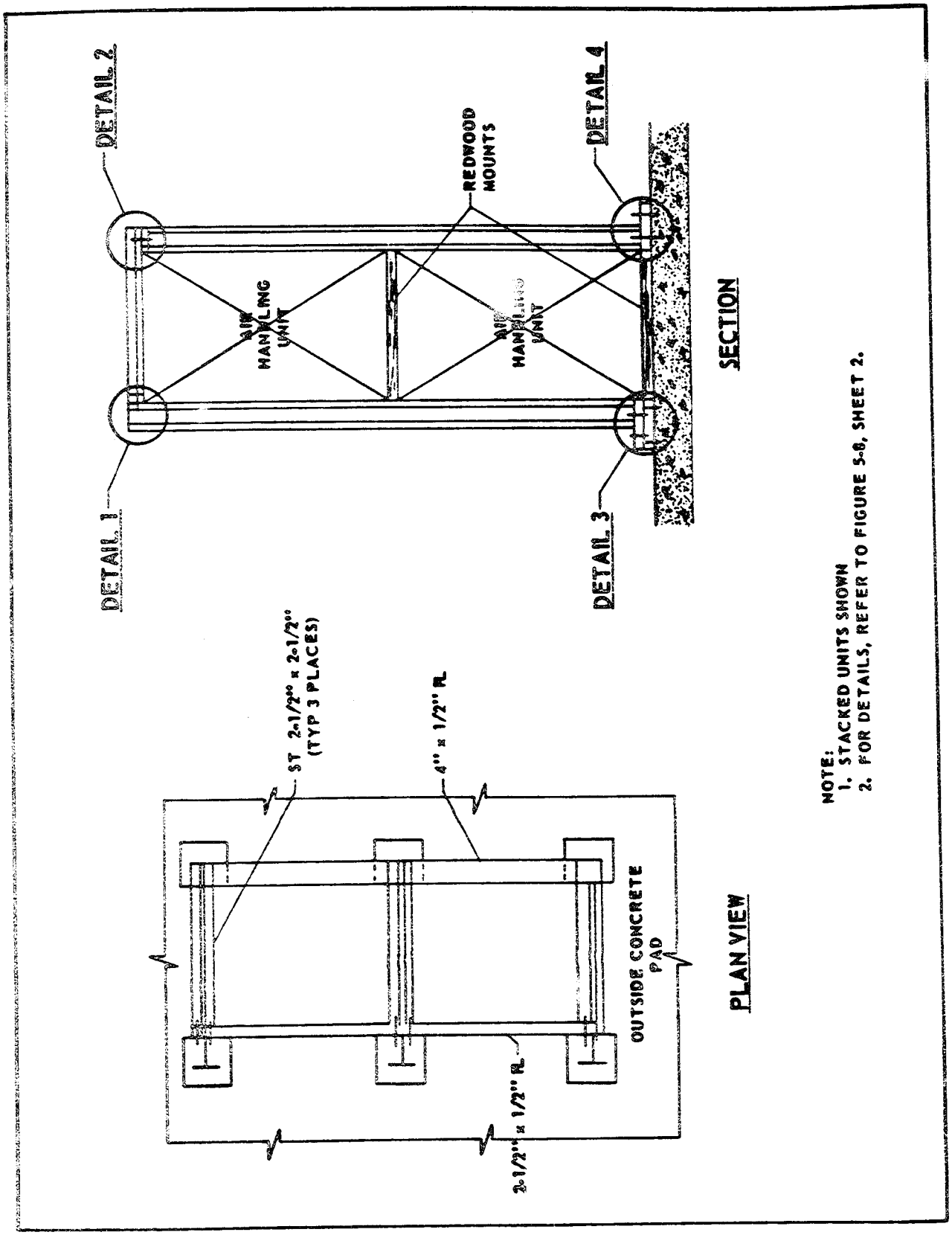


FIGURE 5-8. A.C. UNIT HOLDDOWN (SHEET 2 OF 2)

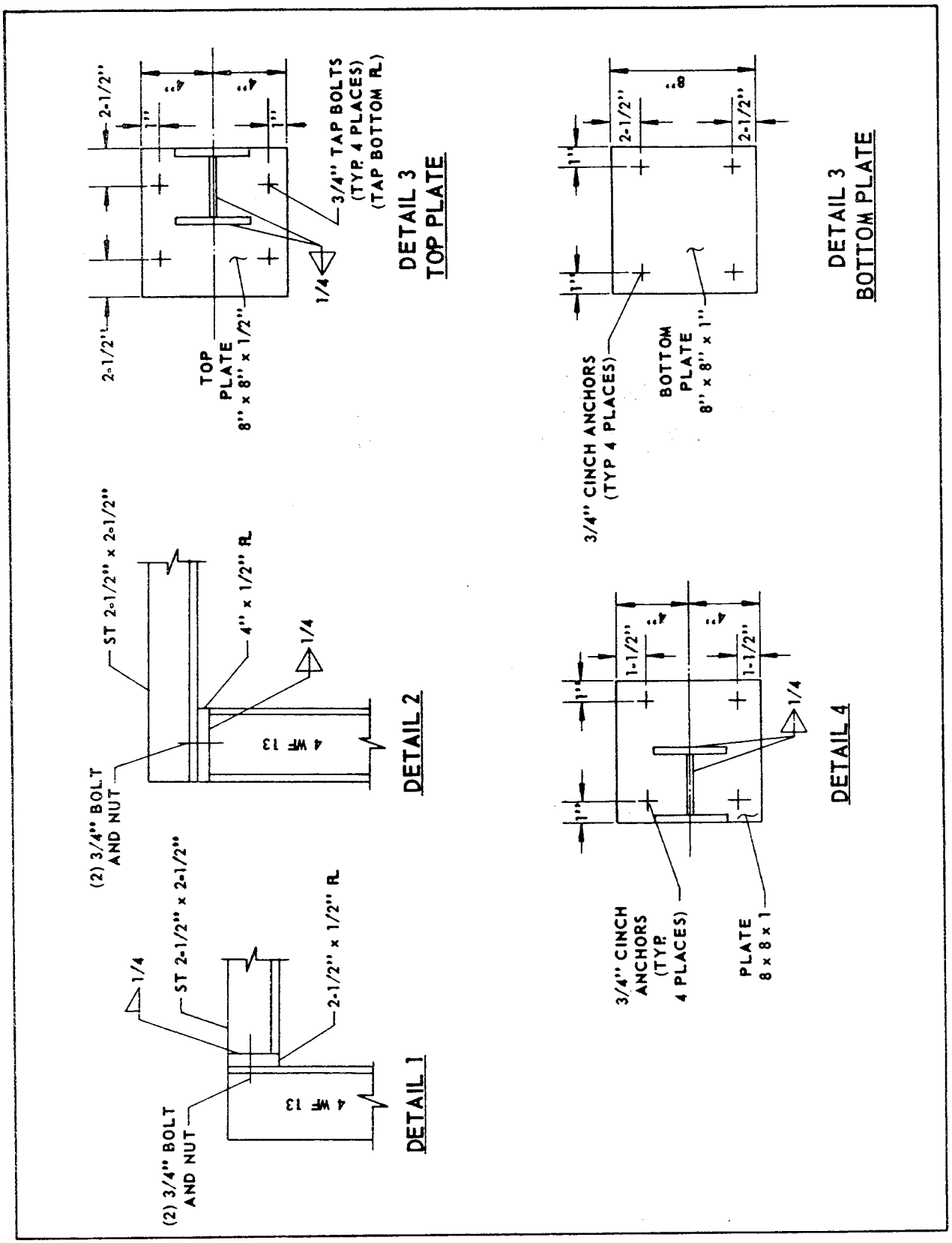
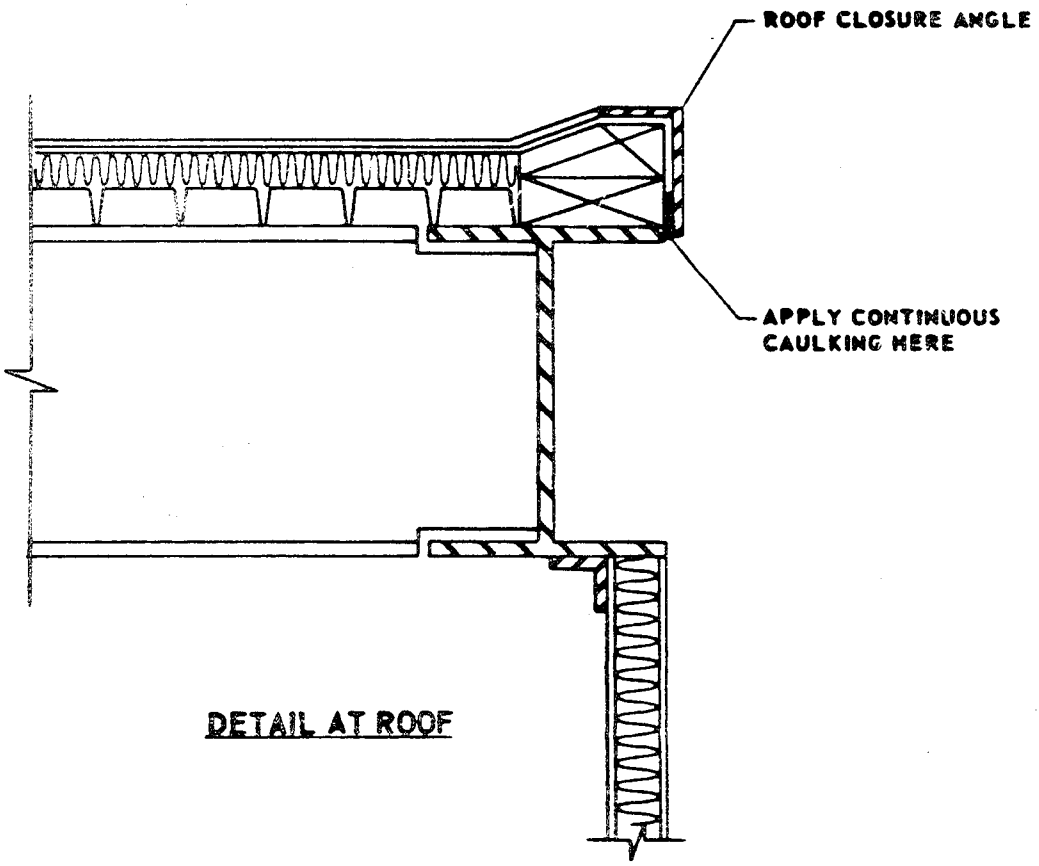


FIGURE 5-9. ATCT TYPE "O", CAULKING AT TOWER ROOF LINE



(2) Install drain holes in low points of all exposed conduits.

43. POST EMERGENCY OPERATIONS. Procedures necessary to restore operations, and implement salvage and cleanup after occurrence of any natural disaster are discussed in Chapter 1.